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ABSTRACT

This paper presents numerous approaches that teachers may use to help pupils deal with difficulties in reading comprehension in mathematics. It discusses the importance of understanding the meaning of the words and symbols used. It argues that: (1) pupils need adequate background information prior to reading story or word problems; (2) a hands-on approach in reading word problems should be used; (3) teachers can use a variety of techniques to teach the abstract words in story problems; (4) pupils may need to be shown the purpose involved in reading story or word problems; (5) pupils need opportunities to read mathematics in many lifelike situations; (6) an environment which encourages learning about mathematics is important; (7) ideas within each lesson in mathematics should be discussed thoroughly; (8) pupils need to relate what they learn in school and in society; (9) readiness activities need to be related to the ongoing processes of reading orally or silently; and (10) pupils need to think creatively and critically in mathematics. The paper concludes that mathematics teachers need to study how well each pupil is doing in reading content in mathematics so they may be in a better position to meet needs of learners in the classroom setting. (SC)

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The Mathematics Curriculum and Reading

by Marlow Ediger

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THE MATHEMATICS CURRICULUM AND READING

A good mathematics teacher needs to be proficient in assisting each pupil to be an excellent reader of word problems and symbols used in mathematics. Many pupils do not do well in word problems due to not understanding what has been read. There are numerous approaches that teachers may use to guide pupils in understanding what was read in the mathematics curriculum. I will discuss what teachers may do to help pupils deal with difficulties in reading comprehension in mathematics. I have observed good teachers use these approaches when supervising student teachers and cooperating teachers as a university supervisor in the public schools.

It is certainly important for pupils to have adequate background information prior to reading story or word problems. If pupils lack this information, they cannot possibly read with understanding. For example, if pupils are to read word problems dealing with multiplication involving a three place multiplicand and a one place multiplier without carrying, they need to have experienced the following previously:

1. the place value meaning of ones, tens, and hundreds in the multiplicand.
2. the meaning of "X" or "times" in the multiplier.
3. the distributive property of multiplication in that the multiplier "distributes itself" evenly over the ones, tens, and hundreds in the multiplicand.
4. the meaning of the product in multiplication.
5. the identification and meaning attached to the abstract words in the word problem.

There are key concepts involved when reading words and mathematical symbols. Symbols stand for for meanings. Each word has a pronunciation and a contextual meaning within a sentence. Abstract symbols also need to be understood by learners, such as +, -, X, and =,

among others as they are being studied in ongoing lessons or units of study . To understand words and symbols, pupils need a variety of learning opportunities which guide meaning and learning. Realia should be used such as objects and items. The pictorial may do much as learning opportunities to assist pupils to understand what is begin taught. Using realia as well as the pictorial helps pupils to attach meaning to abstract symbols used in mathematics (Ediger, 1996, 156-158).

Second, in addition to having adequate background information, a hands on approach should be used to assist pupils in reading word problems. Each pupil needs to make and have access to a place value chart that has ones, tens, and hundreds columns. With congruent rectangular strips of construction paper, learners may then manipulate and place the correct number of strips for the ones, tens, and hundreds in the place value chart. If the value of the multiplicand is 431, the pupil may place one strip in the ones column, three strips in the tens column, and four in the hundreds column. If the multiplier is the numeral "2," pupils need to determine what the product would be. These experiences involve a hands on approach to establish meaning in mathematics. Understanding place value emphasizes many learning opportunities for pupils to experience that assist in attaching meaning to ones, tens, and hundreds. A variety of methods and materials should be used to aid pupils in truly understanding place value, as well as the multiplier in a multiplication problem.

Third, how should the mathematics teacher handle the abstract words in the story problem for pupil reading, referred to above? With early primary grade pupils, A Big Book may be used. Here, the print is large enough for all to see in a group or within the entire class. The teacher accesses background information within pupils and uses manipulative materials, prior to reading aloud from the Big Book. Pupils need to follow along in reading when the teacher reads orally. Next, pupils together with the teacher read aloud from the Big Book containing the word problems. In this way, pupils are not hindered by any unknown

words when they read. Nor are they hindered from reading the abstract symbols in the word problems (See Kennedy and Tipps,1995, Chapter Five).

Older pupils also need to have the necessary background experiences together with manipulative teaching materials activities prior to reading words contained in the word problem. Later primary and intermediate grade pupils who lack reading proficiency skills may have an accompanying cassette record play the contents as these pupils follow along in their basal textbook when word problems are involved. With this approach, pupils do not experience word recognition problems which may well hinder comprehension. Instead of a cassette recording, a good reader may read aloud the content in word problems to those who need assistance due to a lack of reading skills. It is important that pupils secure the ideas in a word problem rather than stumble over unrecognized words. All pupils, regardless of achievement, need to be respected in the classroom. Ridiculing any pupil hinders that learner from achieving more optimally.

If intermediate grade pupils tend to read word problems fairly well, the teacher may introduce new words by printing them in neat manuscript style on the chalkboard. He/she then reads each word carefully with involved pupils. The identification and reading of words from the chalkboard helps these pupils to transfer these learnings to silent reading of word problems. No pupil is to fail due to not reading well. Success for each pupil makes for future success in oral and silent reading. I have also observed whereby selected adult volunteers listen to pupils who have difficulty in word recognition read the subject matter in word problems. These volunteers have had a brief session on how to help pupils in reading. Not all volunteers have worked out well when listening to pupils reading orally. Teachers are quite busy and may not have had ample opportunities to instruct volunteers. Then too, there are volunteers who just do not work out well in the classroom. This just is not their cup of tea. In some schools, retired teachers have assisted pupils in reading word problems. This might be a solution in securing

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volunteers who are trained in teaching. What is important in volunteering is that pupils secure the assistance needed in reading and understanding word problems in mathematics.

Fourth, there are pupils who do not feel there is purpose involved in reading story or word problems in mathematics. Reasons are then lacking by the pupil in reading word problems in mathematics. I would like to digress a little here and tell about Holdeman Mennonite pupils whom I taught in a two teacher rural school, 1955-1957. Holdeman Mennonite children attend school for eight years only. Eighth grade education is terminal. These children found no purpose in reading and discussing social studies content. I struggled in attempting to find ways of motivating these pupils to read social studies materials. In contrast, Holdeman Mennonite children were easily motivated to reading word problems as well as drill and practice activities in mathematics. Why? Seemingly, these children found many values in mathematics as a practical subject, useful in farming. And to be sure, farmers need to know much mathematics in every day farm endeavors. Now coming back to perceiving purpose in leaning on the part of children who fail to see these purposes. Many good teachers have collected receipts, printouts, newspaper advertisements, and statements from every day life for pupils to see how valuable mathematics truly is in their lives. Practicality has convinced many pupils that one cannot exist in modern society unless a working knowledge of mathematics is possessed. I frequently visit numerous Old Order Amish schools near Bloomfield, Iowa and these pupils are very diligent in working word problems and knowing the basic addition, subtraction, multiplication, and division facts. I have a printout in front of me on Old Order Amish pupil achievement in mathematics from these six schools and they compare very favorably with other pupils in the state of Iowa, based on test results from the Iowa Test of Basic Skills. For these Amish children, mathematics as a practical subject is much more useful as compared to other curriculum areas. Eighth grade education is terminal for Amish children. Purpose for learning is vital in

mathematics due to farming endeavors where mathematics is inherent in life. But so is it significant in every day endeavors for all children. Pupils then need to be shown how vital mathematics in life truly is. Time taken to explain purpose for learning is time well spent. Purpose for learning in each mathematics lesson needs to be developed within pupils.

Fifth, pupils need opportunities to read mathematical in many lifelike situations. There are excellent library books written for children in mathematics. The National Council Teachers of Mathematics (NCTM) Standards pertaining to communication, reasoning, and connections (1989) lists the following goals for grades five through eight pertaining to Standard Two-- Mathematics as Communication:

* model situations using oral, written, concrete, pictorial, graphical, and algebraic methods.

* reflect on and clarify their own thinking about mathematical ideas and situations.

* develop common understandings of mathematical ideas, including the role of definitions.

* use the skills of reading, listening, and viewing to interpret and evaluate mathematical ideas.

* discuss mathematical ideas and make conjectures and convincing arguments.

* appreciate the value of mathematical notations and its role in the development of mathematical ideas.

Starred item #4 above pinpoints reading as a very important goal in communication of content in mathematics. The other starred items tend to relate to reading such as in starred item #1 above with oral, written, concrete, pictorial, graphical, and algebraic methods involve reading of symbols or words. Thus what is

1. said orally may be written down and read.

2. concrete construction items, related to what has been learned in mathematics by the involved pupil, may be evaluated as one way of showing what has been learned. The concrete object might also be

described in writing and the related contents read.

3. pictorial method might also be used by the learner to draw what has been learned in an ongoing lesson or unit of study in mathematics. The drawing may be described in writing and the related ideas read.

4. line, bar, and picture graphs may describe data in organized form. Skills are needed to make, read, and attach meaning to diverse kinds of graphs.

5. algebraic sentences, containing symbolic content, may be read by pupils.

NCTM places much emphasis upon the many ways of communicating ideas clearly in mathematics.

Fifth, an environment which encourages learning about mathematics is important. An attitude is communicated when there are attractive and informative bulletin board displays on learning in mathematics. A very important bulletin board display may be developed on reading of library books pertaining to mathematics. Book jackets from new library books along with related print discourse can make for a good bulletin board display. Library books should be on different reading levels and on diverse topics in mathematics. Pupils individually may select a library book to read on his/her level of achievement as well as one based on personal interests in mathematics content. For extra credit, pupils might write a short summary of ideas gathered from reading these library books. Another approach may be to give an oral book report to a committee or the class as a whole. I am suggesting here that pupils choose the way they wish to report on content read. With the theory of multiple intelligences (Gardner, 1993), mathematics teachers need to have an open ended approach on how learners reveal what has been learned. The multiple intelligences reports should not hinder, but encourage more reading. Thus, pupils may indicate multiple intelligences learnings theory through music, art, kinesthetic approaches, and drama. Reading for enjoyment is a major goal here. Learners intrinsically need to read to achieve higher goals in the

mathematics curriculum as well as read for personal satisfaction. Reading mathematical content assists pupils to achieve more optimally in the cognitive domain of objectives. Also, pupils should develop well emotionally or in the attitudinal dimension. If pupils can select what to read, this should make for improved attitudes toward mathematics since they are selecting what is of personal interest to read.

Sixth, ideas within each lesson in mathematics should be discussed thoroughly. Pupils may attempt to memorize answers and content in mathematics, but this does not stress meaning and understanding. Through discussions, pupils indicate what is understood, what is hazy, and what is misunderstood. During the discussion, in an atmosphere of respect, pupil errors may be corrected. Pupils need to feel that comments can be made without criticism. Learners individually, in a relaxed learning environment, should bring up for discussion what is not understood in an ongoing lesson or unit of study. Discussions can be quite enjoyable for pupils when ideas are challenged and new problems identified in a wholesome situation. Rudeness and negative criticisms must be avoided if pupils are to become good members of a discussion group. The discussion may involve the class as a whole or a small group or committee. Pupils can learn much from each other as well as from the teacher. Pupils need to develop feelings of belonging and have esteem needs met. When feelings of belonging persist, pupils feel they are appreciated members of the group. Talents and abilities of pupils need to be recognized in order that esteem needs are met.

Seventh, pupils need to relate what has been discussed to applying these learnings in school and in society. Objectives achieved in the reading curriculum need to be related to reading word problems in mathematics. Reciprocal relations also need to be in evidence involving reading, listening, speaking, and writing emphasized in mathematics and the language arts. In discussions, children need to learn the skills of speaking and listening. What has been discussed lends itself well to writing summaries of relevant ideas in mathematics. With multiple

intelligences theory, mathematics and art may be correlated. Thus, art products might be an excellent way of showing what has been learned in mathematics, such as triangles, squares, rectangles, and circles, among other geometrical figures to show people, buildings, and businesses in a city. Mathematics may also be related to kinesthetic development in physical education. For example, many young children learn counting through rope jumping chants. There are numerous songs in music that stress learning the counting numbers sequentially. The mathematics teacher needs to be flexible in using knowledge and skills from other curriculum areas to assist pupils to achieve optimally in mathematics. Mathematics and the other curriculum areas are not taught as being related for the sake of doing so, but rather to assist pupils to use personal intelligences to learn as much as possible in mathematics.

Eighth, readiness activities for reading mathematics word problems need to be related to the ongoing processes of reading orally or silently in a meaningful manner. The pupil needs to understand and comprehend content in word problems so that use can be made in numerous situations of subject matter acquired. Rereading, oral reading with the teacher, and paying attention to difficulties in word recognition are ways to assist pupils to learn from and engage actively in problem solving experiences in mathematics. There are pupils who read content well in mathematics and these should be encouraged to move forward in independent reading. The needs of individual pupils must be identified and met in a quality mathematics curriculum.

Ninth, ultimately, pupils need to think critically and creatively in mathematics. With critical and creative thinking, the pupil should be in a better position to solve problems in school and in society involving mathematics.

Word Analysis in Mathematics

There are always questions abut how much word analysis in reading mathematics content should be emphasized. My answer is that the teacher makes judgments on how much stress should be placed upon

analyzing unknown words for pupils. Certainly, pupils need to experience meaning in the mathematics curriculum when reading. If the print discourse does not make sense to pupils, they are handicapped indeed in achieving well in mathematics. I would like to discuss additional approaches that may be used in teaching pupils to read mathematical content. Each of these procedures should be taught in context.

Pupils individually may need assistance in knowing initial consonants of words being read in mathematics. After knowing the individual consonant, the pupil may be able to identify that word. For example, the pupil is reading the sentence, "How much did he pay for the ----." Words that would fit in contextually are endless here. If the unknown word starts with "m," that consonant is indeed consistent in sound/symbol relationships. The mathematics teacher may ask the pupil which word(s) he/she knows that start with the "m" sound. The pupil may respond with "money." The unknown word in the sentence, however, deals with something that is bought. There are several answers that would fit in contextually such as "milk," and "mask," among others. At this point, the pupil is correct with using context clues and the beginning consonant sound of "m." In many cases, these two ingredients, knowing context clues and initial consonant sounds, would provide the unknown word to pupils. However, the unknown word is "merchandise."

A good reader, on the appropriate grade level, will be able to identify most or all of the words when reading word problems from the basal text in mathematics.

What then is needed for the pupil who did not identify the word "merchandise?" If a pupil is competent in dividing an unknown word into syllables, he/she may do that to the unknown word -- mer chan' dise. There are children who can divide/put together words that have been analyzed in terms of being divided into syllables. They are then able to recognize the unknown word.

The pupils with teacher assistance reading the word problem

aloud, will in most cases be adequate for learners to understand the abstract words. If not, rereading helps pupils to attach meaning to the word problem. Showing clear, accurate diagrams of what is involved in the word problem may further clarify meanings. Ultimately, to be a good reader in mathematics, the pupil recalls all words met as basic sight words, immediately recognizable (Ediger, 1997).

Conclusion

The mathematics teacher needs to study how well each pupil is doing in reading content in mathematics. Based on the study of each pupil, the mathematics teacher may be in a better position to meet needs of learners in the classroom setting. In addition to reading, other communication skills need to be developed among learners. Thus, pupils need to be actively involved in teacher lead discussions whereby each pupil may participate with feelings of self respect. Collaborative endeavors with peers also need to be a part of the mathematics curriculum. Pupils then need to learn to work together to solve problems in mathematics. Accurate writing of the summaries should be an important end result. Being a good listener helps pupils to be better participants in discussions and better writers and summarizers of content discussed. A variety of ways need to be in the offing whereby pupils show what has been learned in mathematics. Verbal skills such as reading and writing are important. Additional skills include art work, kinesthetic approaches, drama, and music. Optimal achievement on the part of pupils in mathematics is an ultimate objective in teaching and learning (Ediger, 1998, Chapter Eight).

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